STATUTORY DECLARATION

I, Sun Suk KIM, a citizen of the Republic of Korea and a staff member of Y.H.KIM INTERNATIONAL PATENT & LAW OFFICE specializing in "MANUFACTURING METHOD FOR PAD PARTS OF AN LCD AND AN LCD WITH THE SAME", do hereby declare that:

(1) I am conversant with the English and Korean languages and a competent translator thereof.

(2) To the best of my knowledge and belief, the following is a true and correct translation of the Priority Document (No. P1998-25443) in the Korean language already filed with Korean Industrial Property Office on June 30, 1998.

Signed this 16th day of December, 2004

Sun Suk KIM

PATENT APPLICATION

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The present application is filed pursuant to Article 42 of the Korea Patent Act.

Patent Attorney

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ABSTRACTS

[Abstract]

The present invention relates to a manufacturing method of a liquid crystal display (LCD) device for preventing peeling off between a pad and an outer terminal communicating an electric signal each other, and to a pad part structure of an LCD device thereby. In the present invention, a portion of a glass substrate is exposed between pads of a liquid crystal panel. Accordingly, the exposed glass substrate is directly connected to an anistropic conductive film (ACF), an attachment medium, to prevent a portion of a tape carrier package is peeled off.

[Representative drawing]

FIG. 9

SPECIFICATION

[Title of the invention]

MANUFACTURING METHOD FOR PAD PARTS OF AN LCD AND LCD WITH THE SAME

[Brief description of the drawings]

FIG. 1 is a perspective view illustrating a structure of a conventional liquid crystal display device.

FIG. 2 is a sectional view illustrating the structure of the conventional liquid crystal display device.

FIG. 3 is a sectional view illustrating a structure of an anistropic conductive film(ACF).

FIG. 4 is a sectional view showing a method connecting a tape carriage package(TCP) to a pad of a liquid crystal display panel.

FIG. 5 is a sectional view illustrating a state that a passivation layer of the liquid crystal panel is peeled off according to a shrinking force of a film when the TCP is connected to the pad of the liquid crystal panel by using the ACF of a prior art.

FIG. 6 is a sectional view illustrating a state that a passivation layer of the liquid crystal panel is peeled off from an edge portion of the liquid crystal panel according to the shrinking force of the film when the TCP is connected to the pad of the liquid crystal panel by using the ACF of a prior art.

FIG. 7 is a plan view illustrating a liquid crystal panel according to the present invention.

FIG. 8 is a sectional view illustrating a method manufacturing the liquid crystal panel according to the present invention.

FIG. 9 is an enlarged plan view illustrating pad parts of the liquid crystal panel according to the present invention.

<Detailed description of the reference numerals>

1a : a first transparent substrate
1b : a second transparent substrate
3 : a color filter panel
5 : an active panel
7 : a color filter
8 : a common electrode
9 : a black matrix
10 : a liquid crystal material
11, 111 : a gate electrode
13, 113 : a gate(signal) line
15, 115 : a gate pad
17, 117 : a gate insulating layer
19, 119 : a thin film transistor
21, 121 : a source electrode
23, 123 : a source(data) line
25, 125 : a source pad
31, 131 : a drain electrode
33, 133 : a semiconductor layer
37, 137 : a passivation layer
41, 141 : a pixel electrode
57, 157 : a gate pad terminal
67, 167 : a source pad terminal
81 : sealant
91 : an anistropic film
93 : an insulation membrane
95 : a conductive ball
45, 145 : a liquid crystal pad
47, 147 : a liquid crystal pad terminal
149 : a pad contact hole
71 : an anistropic conductive film(ACF)
73 : a tape carrier package(TCP)
75 : a TCP pad
77 : a TCP film
83 : a pulling force

85 : a vertical shrinking force
87 : a horizontal shrinking force
89 : a peeling force
1, 101 : a substrate
211 : a first metal layer
213 : a second metal layer
135 : a doped semiconductor layer

[Detailed description of the invention]

[Object of the invention]

[Technical field including the invention and prior art therein]

The present invention relates to a method and a structure for manufacturing a liquid crystal display (LCD) device, and in particular, the present invention relates to a manufacturing method of a liquid crystal display (LCD) device for preventing peeling off between a pad and an outer terminal communicating an electric signal each other, and to a pad part structure of an LCD device thereby.

The braun tube (or the cathode ray tube(CRT)) among display devices displying a picture data in a screen is mostly used, however, it was difficult to use because it has a large volume and weight in compared with a display area. Accordingly, a thin flat panel display device, having a thinner thick, possible to use easily in anywhere has been developed even though its display area is large, and is gradually replacing the braun tube. More particularly, the liquid crystal display(LCD) device has a higher resolution than other flat panel display devices, and its response time is faster than that of the braun tube. Thus, it is focused on the development of liquid crystal display devices.

The liquid crystal display device is driven by an optical anisotropy and polarization of a liquid crystal material. Since the structure of the liquid crystal material is thin and long, a direction of liquid crystal molecules can be controlled by applying electromagnetic

field to the liquid crystal molecules, having a direction and a polarization in a molecules arrangement. Thus, if an alignment direction is temporality controlled, then light can be transmitted or blocked in accordance with the alignment direction of the liquid crystal molecules by the optical anistropic of the liquid crystal material. Accordingly, the LCD device is applying as a display device. Since an active matrix LCD having a thin film transistor(TFT) arranged in a matrix pattern and pixel electrode connected to the TFT provides high quality images and natural colors, the active matrix is now remarkable product.

A structure of a liquid crystal panel, a basic part of a conventional active matrix LCD, will be described as follows. FIG. 1 is a perspective view illustrating a structure of a conventional liquid crystal panel, and FIG. 2 is a sectional view illustrating the conventional liquid crystal panel taken along a line II-II.

The liquid crystal panel comprises an upper panel 3 and a lower panel 5, which have a various elements each other, with a liquid crystal material 10 injected therebetween. One panel of the liquid crystal display device comprises elements implementing colors. The one panel is called as the color filter panel 3. The color filter panel 3 includes a sequential arrangement of red(R), green(G), blue(B) color filters 7 on a first transparent substrate 1a at pixel positions designed in a matrix pattern. Among these color filters 7, black matrixes 9 are formed in a lattice pattern.

The black matrixes prevent the colors from mixing at the boundary area. Further, a common electrode is formed to cover the color filters 7. The common electrode 8 is one electrode generating an electric field applied to the liquid crystal material 10.

Another panel of the liquid crystal display device comprises switching elements and lines, generating the

electric field for driving the liquid crystal material. This panel is called as the active panel 5. The active panel 5 includes pixel electrodes 41 designed in a matrix pattern and formed on a second transparent substrate 1b. The pixel electrode is another electrode, facing the common electrode 8 formed on the color filter panel 3 and generating the electric field applied to the liquid crystal material 10. A signal line 13 is formed along the row direction of the pixel electrodes, and a data line 23 is formed along the column direction of the pixel electrodes 41. In a case of the active matrix liquid crystal display device, a TFT 19, a switching element for applying the electric field signal to the pixel electrode 41, is formed a corner of a pixel electrode 41. A gate electrode 11 of the TFT 19 is connected to the signal line 13(Accordingly, the signal line is also called as a gate line), and a source electrode 21 is connected to the data line 23(Accordingly, the data line is also called as a source line). Further, a drain electrode 31 of the TFT 19 is connected to the pixel electrode 41. In the TFT 19, a semiconductor layer 33 is formed between the source electrode 21 and the drain electrode 31, and an ohmic contact exists between the source electrode 21 and the semiconductor layer 33 and between the drain electrode 31 and the semiconductor layer 33. A gate pad 15 and a source pad 25, the terminals of the lines, receiving signals applied from an exterior, are respectively formed at the end portion of the gate line 13 and the source line 23. Additionally, a gate pad terminal 57 and a source pad terminal 67 are formed on the gate pad 15 and the source pad 67, respectively.

As the external electric signal applied to the gate pad 15 is applied to the gate electrode 11 via the gate line 13, a picture data applied to the source pad 25 is applied to the source electrode 21 via the source line 23 to be sent to the drain electrode 31. On the other hand, as

a signal is not applied to the gate line 13, the source electrode 21 is disconnected. Therefore, by controlling the signal of the gate line 13, an existence of applying the data signal to the drain electrode 31 can be determined. Thus, the data signal can be transferred to the pixel electrode 41 connected to the drain electrode 31. In other words, the TFT 19 acts as a switching element for driving the pixel electrode. A gate insulating layer 17 is formed between the layer including the gate line 13 to electrically isolate them and the layer including the source line 23, and a passivation layer 37 is formed on the layer including the source line 23 to protect all elements.

The color filter panel 3 and the active panel 5 are bonded together to face each other with a certain separation distance therebetween (i.e., a cell gap). Liquid crystal material fills the cell gap. The edge of the bonded panels is sealed with a sealant 81 such as an epoxy to maintain the cell gap and to prevent the liquid crystal material from leaking out so that a liquid crystal panel, a main part of the liquid crystal display device, is completed.

The completed liquid crystal panel is connected to a picture data input device to complete a liquid crystal display device. At this time, the pads of the liquid crystal panel and the terminal of the picture data input device are connected with a tape carrier package(TCP) using an anisotropic conductive film(ACF).

As shown in FIG. 3, the ACF 71 comprises a plurality of conductive ball 95 coated with an insulation membrane 93 in an anistropic film 31. On the pad terminals 47 connected to the pads 45 (for example, the gate pad 15 or the source pad 25) of the liquid crystal panel, the ACF 71 is attached and TCP 73 is attached thereon. At this time, the conductive pad 75 of the TCP 73 is aligned with the pad 45(for example, the gate pad 15 or the source pad 25) of the liquid crystal panel, as show in FIG. 4A. The TCP 73 is

pressed and heated while the conductive balls 95 are inserted between the TCP pad 75 and the pad terminal 47 of the liquid crystal panel. When sufficient pressure is applied against the TCP 73, the insulating membrane 93 covering the conductive ball 95 are broken so that each TCP pad 75 becomes electrically connected to each pad terminal 47 of the liquid crystal panel, as shown in FIG. 4B. Even if there are some conductive balls 95 between the neighbored pad terminals 47, the neighbored pads 45 are electrically isolated from each other because the conductive balls 95 are covered by the insulation membrane 93.

[Technical Subject Matter to be solved by the Invention]

In the step of attaching the TCP to the pad terminal as mentioned above, the ACF is inserted between the pad of the TCP and the pad of the liquid crystal panel by some pressure and heat. As shown in FIG. 5, the film portion 77 between pads 75 of the TCP 73 are expanded somewhat as the ACF, and becomes connected to the passivation layer 37 formed on the top of the liquid crystal panel. After removing the pressure and the heat, the expanded film portion of the TCP is shrunk which results in the pulling force 83 so that the ACF and the passivation layer 37 being cohered with the film portion 77 are peeled off.

More particularly, during the process of manufacturing the liquid crystal panel, there is possible to have a case that a shorting line portion for preventing an electrostatic formed at the edge of the liquid crystal panel is trimmed off. In this case, since the gate insulating layer and the passivation layer deposited on the glass substrate are stressed by an external force in the trimmed process, an adhesion force of the trimmed edge portion of the liquid crystal panel becomes unstable. At this trimmed portion, the passivation layer 37 or the gate insulating layer 17 can be easily peeled off when the

pressure and the heating energy are removed during the process cohering the film portion of the TCP to the passivation layer 37 with the ACF therebetween. This comes from the peeling force 89 made of he vector summation of the horizontal shrinking force 87 of the ACF 71 and the vertical shrinking force 85 of the ACF 71 and TCP 73, as shown in FIG. 6.

Accordingly, it is object of the present invention to suggest a method for manufacturing the liquid crystal panel with enhanced structural integrity of the liquid crystal panel in which the adhesion force of the TCP and the liquid crystal panel is enhanced when the TCP for communicating information with an external signal processor is attached to each pad of the liquid crystal panel.

Another object is to suggest a method for manufacturing the liquid crystal panel, in which the ACF inserted between the TCP and the pad of the liquid crystal panel is directly cohered with some portion of the glass substrate of the liquid crystal panel, to enhance adhesion force.

[Configuration and Operation of the Invention]

In order to accomplish these objects, the present invention comprises steps of: forming a thin film transistor having a gate electrode, a source electrode and a drain electrode, a gate line connecting the gate electrode, a source line connecting the source electrode and, a gate pad and a source pad formed at the end of the gate line and the source line, respectively on a substrate; depositing a passivation layer covering the thin film transistor and the pads; patterning the passivation layer to expose the gate pad and the source pad; and exposing a portion of the substrate between the pads. Also, the present invention by the above-mentioned method comprises a plurality of gate lines, a plurality of source lines, a gate pad and a source pad formed at the ends of the gate

line and the source line, respectively, on a substrate, and a plurality of exposing hole exposing the substrate between the gate pad and the source pad.

These and other aspects, features and advantages of the present invention will be better understood by studying the detailed description in conjunction with the drawings and the accompanying claims.

FIG. 7 is an enlarged plan view of liquid crystal panel according to the present invention, and FIG. 8 is a sectional view representing a process manufacturing the liquid crystal panel according to the present invention. On a transparent glass substrate 101, a metal such as aluminum Al or aluminum alloy is deposited to form. Further, a metal having a high melting point such as molybdenum Mo, tantalum Ta, tungsten W or antimony is sequentially deposited to form a second metal layer 213. The above double layer is etched through a first mask process to form a gate line 113, a gate electrode 111, and a gate pad 115. At this time, the second metal layer 213 and the first metal layer 211 are patterned by a wet etching method to form gate materials (for example, the gate line, the gate electrode, and the gate pad) which the second metal layer 213 having a width narrower than that of the first metal layer 211 is stacked). A plurality of the gate lines 113 procedure in a horizontal direction of the substrate 101 is arrayed and fabricated in a vertical direction of the substrate 101. The gate electrode 111 is derived from the gate line 113 and formed at a corner of the designed pixel. The gate pad 115 is formed at the end of the gate line 113, as shown in FIGs. 7 and 8A.

On the substrate 101 having the gate material stacked with the first metal layer 211 and the second metal layer 213, and inorganic insulating material such as a silicon nitride SiN_x or a silicon oxide SiO_x or an organic insulating material such as BCB(bezocyclobutane) of acrylic resin is coated to form a gate insulating layer 117. An

intrinsic semiconductor material, such as a pure amorphous silicon, and an extrinsic semiconductor material, such as an impurity doped amorphous silicon, are sequentially deposited thereon. These stacked layers are patterned using a second mask process to form a semiconductor layer 133 and a doped semiconductor layer 135. They are disposed on the gate insulating layer 117 over the gate electrode 111, as shown in FIGs. 7 and 8B.

A metal such as chrome Cr or chrome alloy is deposited on the substrate 101 having the doped semiconductor layer 135, and then is patterned using a third mask process form a source line 123, a source electrode 121, a drain electrode 131, and a source pad 125, etc. A plurality of the source lines 123 perpendicularly crossing each gate line 113 on the gate insulating layer 117 is arrayed in a horizontal direction. On one side of the doped semiconductor layer 135, the source electrode 121 derived from the source line 123 is formed. On the other side of the doped semiconductor layer 135, the drain electrode 131 facing the source electrode 121 is formed. The source pad 125 is formed at the end of the source line 123, as shown in FIGs. 7 and 8C.

On the substrate having the source materials (for example, the source line, the source electrode, the drain electrode, the source pad, and the source shorting line), an inorganic insulating material such as a silicon nitride SiN_X, a silicon oxide SiO_X is deposited or an organic insulating material such as BCB(benzocyclobutene) or acrylic resin is coated to form a passivaion layer 137. Some portion of the passivation layer 137 covering the source pad 125 and the drain electrode 131 are removed using a fourth mask process to form a source contact hole 161 and a drain contact hole 171. Herein, some portions of the passivation layer 137 and the gate insulating layer 117 between each gate pad 115 and each source pad 125 are removed to form a plurality of exposing holes 193 exposing

the glass substrate 101, as shown in FIGs. 7 and 8D.

On the passivation layer 137, a transparent conductive material such as ITO (Indium Tin Oxide) is deposited and patterned using a fifth mask process to form a pixel electrode 141, a gate pad terminal 157 and a source pad terminal 167. The pixel electrode 141 connects to the exposed drain electrode 131 through the drain contact hole 171. The gate pad terminal 157 connects to the gate pad 115 through the gate contact hole 151. The source pad terminal 167 connects to the exposed source pad 125 through the source contact hole 161, as shown in FIGs. 7 and 8E.

FIG. 9 is a plan view illustrating the pad portion of the liquid crystal panel according to the present invention. In other words, the exposing hole 193 exposing the glass substrate 101 is formed by eliminating some portions of the gate insulating layer and the passivation layer disposed at the space between the pad portions including the pad 45 and pad terminal 47 contacting to the pad 45 through the pad contact hole 47. Here, in order to enhance the function of the exposing hole 193, it is preferable that the exposing hole comprises a plurality of exposing holes 193, as shown in FIG. 9. In addition, the edge portion of the glass substrate is grinded after trimming process. Therefore, adhesion forces between the glass substrate and the gate insulating layer or passivation layer would be weaken by the external forces applied thereon, during the trimming and grinding processes. As a result, it is more preferable that the exposing hole 193a formed at the edge portion of the glass substrate would be larger than those of other portions, as shown in FIG. 9.

[Effect of the Invention]

The present invention relates to a pad part of a liquid crystal panel, and more particularly, to a manufacturing method of a liquid crystal panel for preventing a weak adhesion force and peeling off between a

pad and a tape carrier package(TCP), and to a structure of a liquid crystal panel thereby. In the present invention, a plurality of holes is formed between pads of the liquid crystal panel to expose a glass substrate. Accordingly, the glass substrate exposed through the exposed holes is directly connected to an anistropic conductive film (ACF), an attachment medium, to prevent a portion of a tape carrier package is peeled off. Thus, it is possible to prevent the TCP peeling off from the pad part after completing a liquid crystal display device.

[What is claimed is:]

1. A method for manufacturing a liquid crystal display device comprising:

forming a plurality of lines and a pad at the end of each line, on substrate;

forming an insulating layer on the line and the pad; and

patterning the insulating layer to expose the pad and some portion of the substrate between the pads.

2. The method according to claim 1, further comprising:

forming a pad terminal on the pad; and

connecting a conductive pad of a line means to the pad terminal, wherein the conductive pad of the line means is arrayed with a designated distance to correspond to an alignment of the pads on an anistropic film, and cohering the exposed substrate between the pad terminals to the anistropic film.

3. The method according to claim 1, wherein the forming the line, the pad, and the insulating layer includes:

forming a gate line having aluminum on the substrate and a gate pad at the end of the gate line;

forming a gate insulating layer covering the gate line and the gate pad;

forming a source line on the gate insulating layer and a source pad at the end of the source line; and

forming a passivation layer covering the source line and the source pad, and

wherein exposing the substrate includes exposing some portion of the substrate among the gate pad, the source pad, each gate pad, and each source pad.

4. The method according to claim 3, wherein

forming the gate line further includes forming a gate electrode derived from the gate line and forming a semiconductor layer in a portion of the gate electrode on the gate insulating layer, wherein forming the source line further includes forming a source electrode derived form the source line and making an ohmic contact with one side of the semiconductor layer, and a drain electrode facing to the source electrode and making an ohmic contact with the other side of the semiconductor layer, and

wherein exposing the source pad further includes exposing the drain electrode and forming a gate pad terminal connected to the exposed gate pad, a source pad terminal connected to the exposed source pad, and a pixel pad terminal connected to the exposed drain electrode.

5. The method according to claim 3, further comprising connecting a conductive pad of a line means to the gate pad terminal and the source pad terminal, wherein the conductive pad of the line means is arrayed with a designated distance to correspond to an alignment of the pads on an anistropic film, and cohering the exposed substrate between the gate pad terminal and the source pad terminal to the anistropic film.

6. A liquid crystal display device comprising:

a substrate;

a plurality of lines formed, in parallel, on the substrate;

a pad formed at the end of the line;

an insulating layer covering the line and pad; and

an exposing hole exposing some portion of the substrate between the pads.

7. The device according to claim 6, further comprising a connection means having a conductive pad electrically connected to the pad and an anistropic film

cohering with the substrate through the exposing hole.

8. The device according to claim 6, wherein a plurality of the exposing holes is formed between the pads.

9. A liquid crystal display device comprising:

a substrate;

a gate line formed, in parallel, on the substrate;

a gate pad formed at the end of the gate line;

a gate insulating layer on the gate line;

a source line crossing the gate lien on the gate insulating layer;

a passivation layer formed on the source line;

a gate contact hole exposing the gate pad;

a source contact hole exposing the source pad; and

an exposing hole exposing some portion of the substrate between each gate pad and each source pad.

10. The device according to claim 9 further comprising:

a gate electrode derived from the gate line;

a semiconductor layer in a portion of the gate electrode on the gate insulating layer;

a source electrode derived form the source line and contacted with one side of the semiconductor layer;

a drain electrode separated from the source electrode by a designated distance and contacted with the other side of the semiconductor layer;

a drain contact hole exposing the drain electrode;

a gate pad terminal connected to the gate pad through the gate contact hole;

a source pad terminal connected to the source pad through the source contact hole;

a pixel electrode connected to the drain electrode through the drain contact hole; and

a connection means, having a conductive pad

electrically connected to the gate pad terminal and the source pad terminal, and having an anistropic film cohering with the substrate through the exposing hole.

FIG. 1

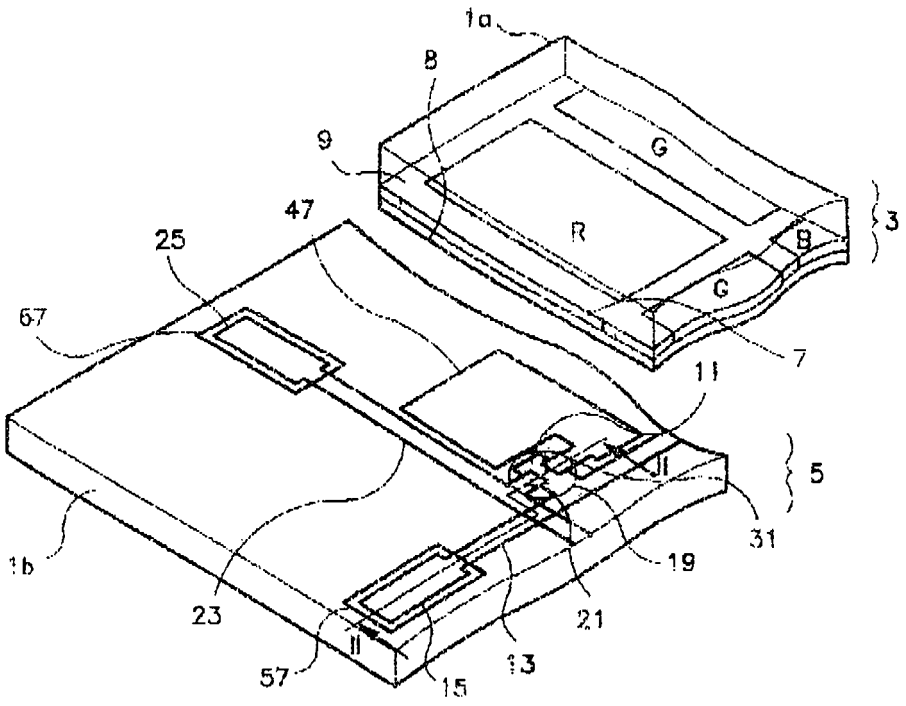

FIG.2

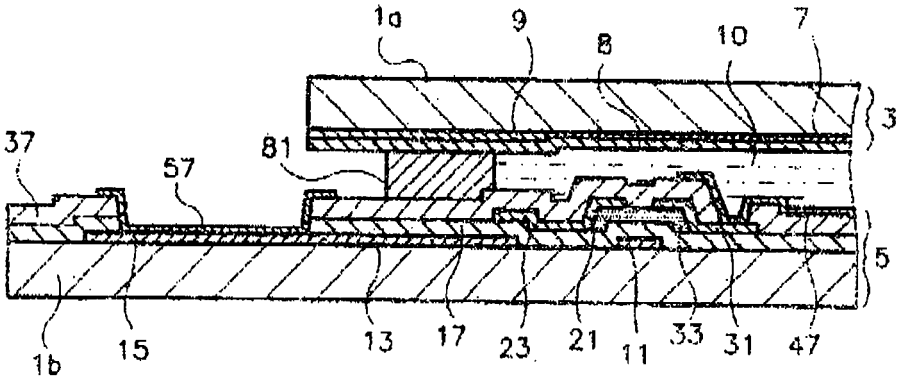

FIG.3

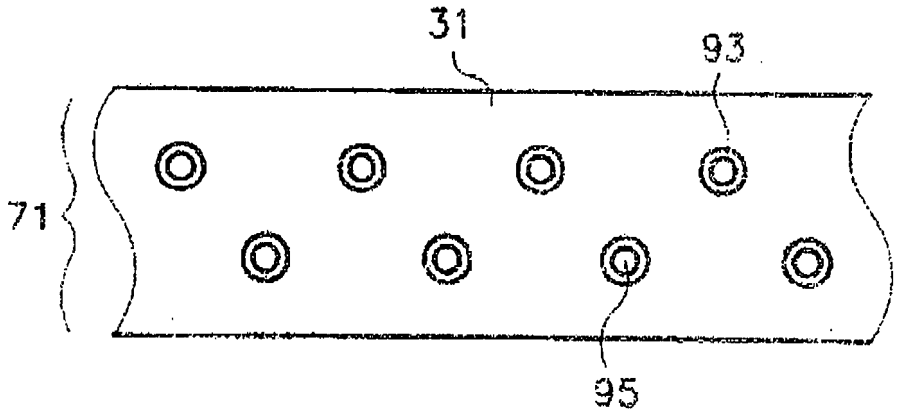

FIG.4A

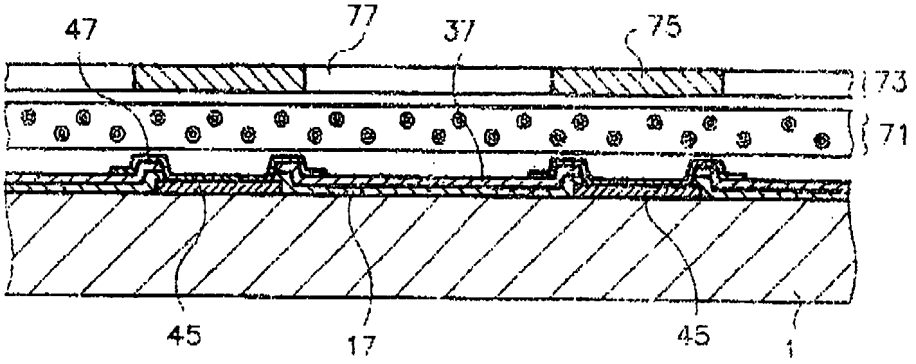

FIG.4B

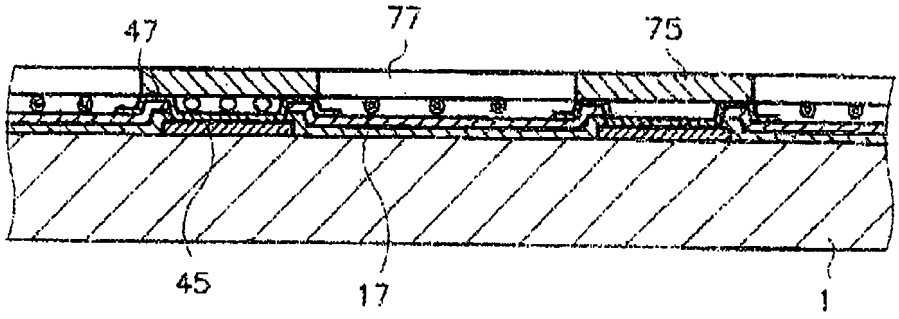

FIG.5

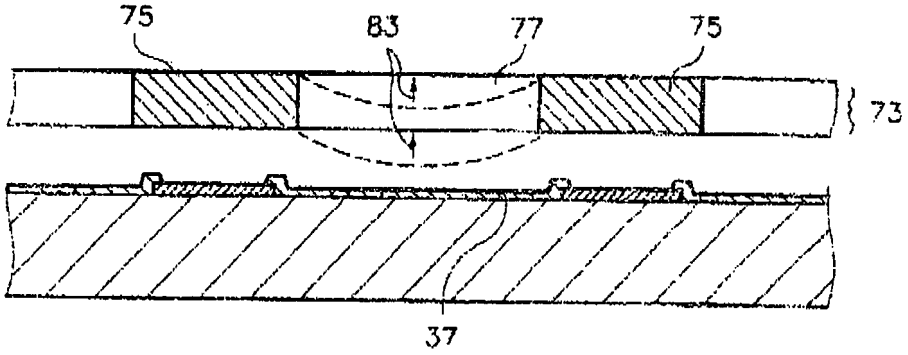

FIG.6

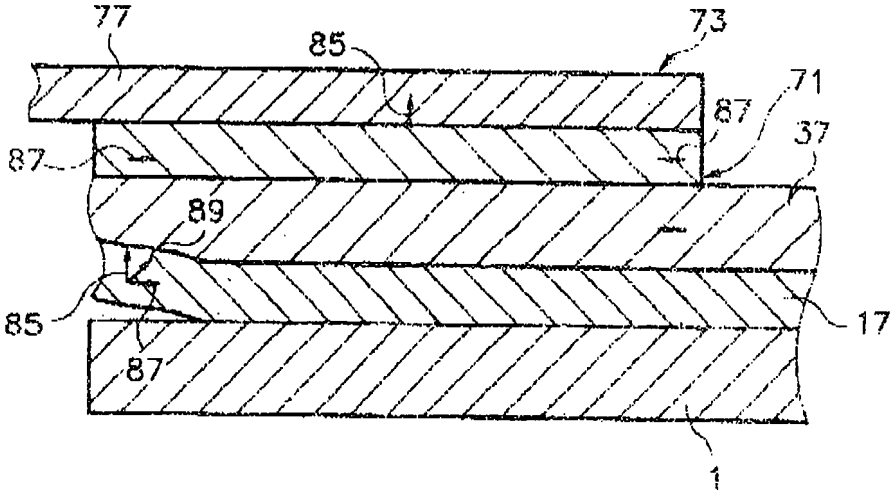

FIG.7

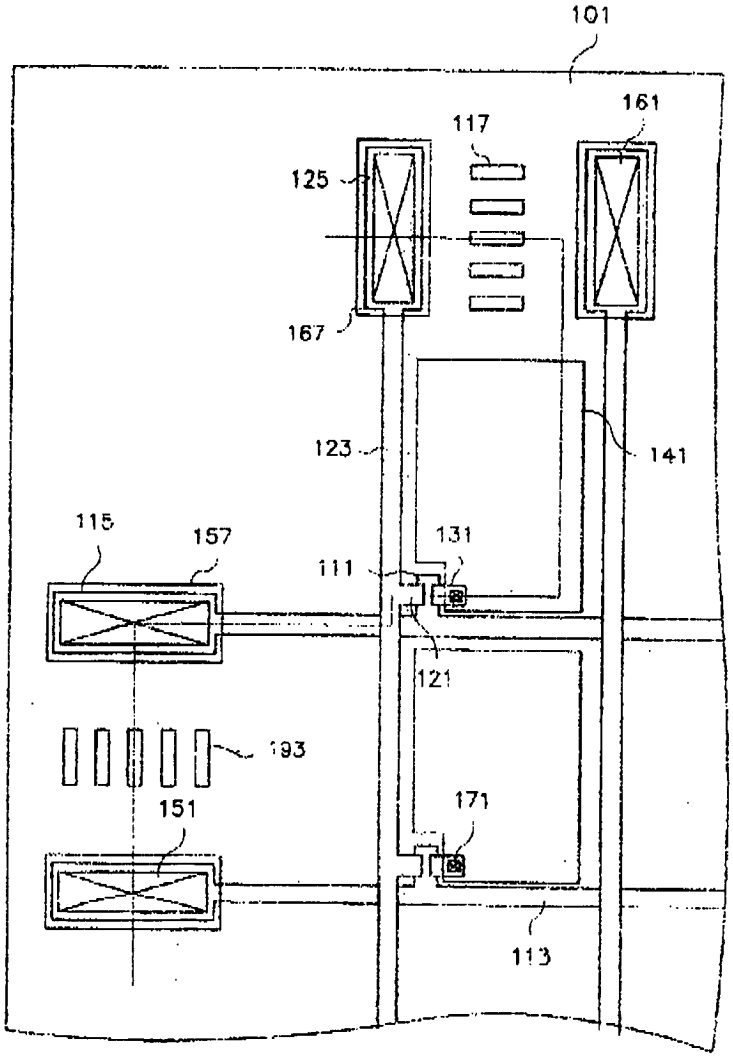

FIG.8A

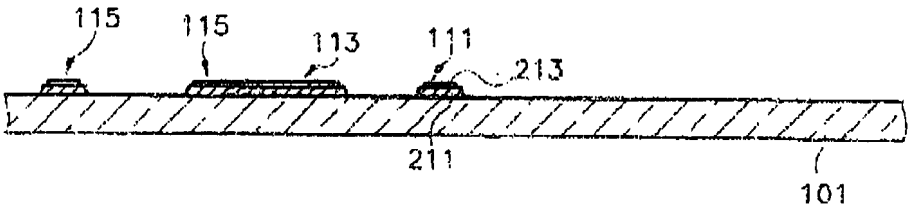

FIG.8B

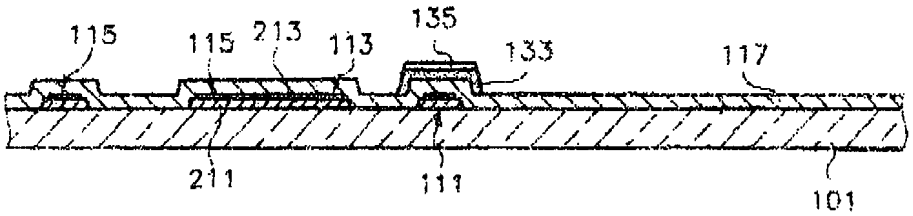

FIG.8C

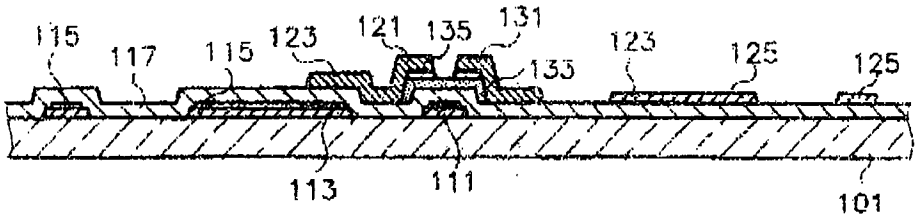

FIG.8D

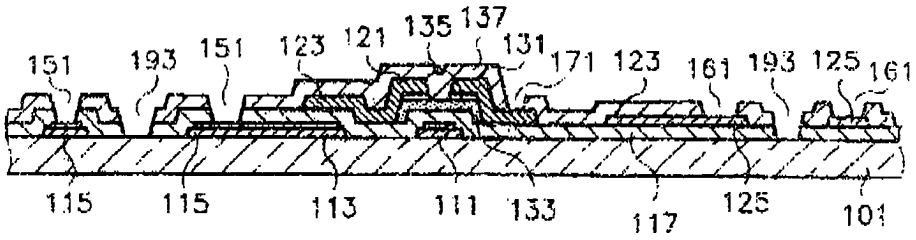

FIG.8E

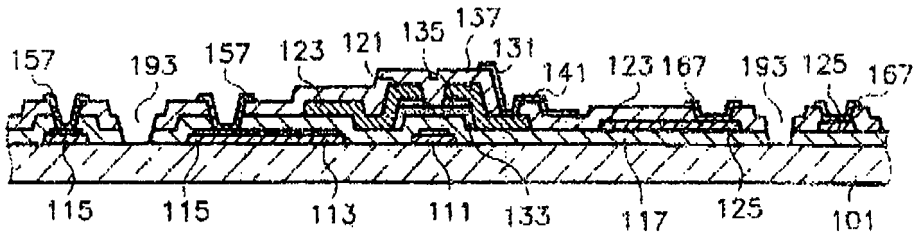

FIG.9